A FEW WORDS ON

THE ART OF FILTRATION,

BY

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THE ART OF FILTRATION.

FILTRATION is generally defined as "the process by which liquids are separated from substances mechanically suspended in them. It is sometimes resorted to to separate colouring matters and other bodies which are removed by the substance or matter through which the liquids are filtered." The earliest recorded instance of the existence of a filter is what is sometimes called "Hippocrates's sleeve," the invention of the father of the medicinal art, who flourished B.C. 450–380. This filter consisted of a woollen strainer, in fact, the modern "jelly-bag," which is so generally employed among chemists and others for straining liquors. So universal has been the adoption of this simple contrivance that the term "filter" is etymologically traced in almost every language to the word "felt," *i.e.*, fulled wool. It is rendered in Anglo-Saxon "*felt*," in Swedish "*filt*," French "*filtre*," Italian "*feltro*," and Latin "*filtrum*" or "*feltrum*," and it seems strange that this material, used for so long a time for straining valuable liquids, has not hitherto been brought into

use for the clarification of water on a large scale. We ho later on to show that it ought to play an important part the settlement of the great question of the day—the wat supply of cities.

It will be remembered that after the first outbreak Cholera in London, in the year 1849, Parliament compell the Thames Water Companies to remove their intakes abo the tidal river, and also to submit their water to a proce of filtration. Thus originated, in the year 1852, the fi filter bed of London, designed by Mr. James Simpson, t engineer to the Chelsea and Lambeth Water Works. Th filter bed consisted of the following media: first, a layer fine sand resting on screened gravel, beneath which lay rubble foundation of stones, varying from the size of a p near the sand, to that of a hen's egg over the arterial drai the whole forming a bed 70 to 80 inches in thickness. A the other Water Companies have since followed the Chels pattern of filter bed, with but slight modifications.

No change in the process seems to have been introduc for the last 25 years, and it is clear that these filter beds not act with efficacy, as proved by Dr. Frankland's rece Report. We are told that one Company delivers water wh is "turbid and contains moving organisms," and that anoth Company's supply is of a "very objectionable quality."

How shall we account for these serious defects in present system? It is acknowledged that quartz sand exe no chemical action on water passed through it. It d indeed intercept the coarser impurities, as seen in the ra growth of "blanket weed" on the surface of a filter bed wh drained. But the finer impurities which abound in all wat are gradually forced through the fine crevices into the coa layers beneath. Moreover when the filter is becoming clog and the head increased, the unfiltered water forces its w downwards through the sand, where the clogging mate offers the least resistance, in actual streamlets, and wha there then in the coarse ballast beneath to arrest th

mpurities? All the layers of sand, stone or shells would seem to be merely useless. In fact, a French engineer, M. D'Arcy, who has written a very interesting account of the English and French Water Works, recognising the uselessness of all this coarse material, concludes by proposing as an improvement on the English and French systems, a circular filtering reservoir of great water depth, with about 12 inches of fine and 4 inches of coarse sand.

One of the great defects of the sand system is the difficulty of thorough cleansing. Every now and then the top portion of the fine layer of sand is pared off for about an inch in depth, a process which gradually reduces the thickness of the sand to an inefficient minimum. This paring does not, however, affect the impurities which are adhering to the surface of the gravel and stones beneath the sand. Another mode of cleansing is in use at Paisley, Marseilles, and other places, that is, reversing the water current, and forcing it *upwards* from under the bed. The great faults of this system are: first, a wholesale waste of water, (which in the case of the Marseilles bed, two acres in extent, entails a loss of over 22,000,000 gallons), secondly, the water used to cleanse the bed being generally unfiltered, leaves in the interior of the filter its own share of dirt, and lastly, as the head for the upward current is at least double that for the downward, it disturbs the regularity of the layers, and opens up actual free passages through the sand. The cost of filter beds, covering, as they do in London, upwards of 70 acres of valuable land, may fairly be urged against them.

But, it may be asked with good reason, if fine sand has proved to be so inefficient a medium, how is it that something better has not been brought into notice since the formation of the Chelsea prototype a quarter of a century ago? The answer really lies in the advantages possessed by the sand system as regards cost of the material itself; other materials such as the Carbide of Iron have been tried and, indeed, used in isolated cases, but Charcoal, which can take precedence of them all as a purifier and strainer, has been found too expensive

for adoption upon a large scale though its claims have been s
often advocated by the best authorities. Where Charcoal ha
been used, no matter in what form or variety, it has simpl
taken the place of sand or sponges and hence the outla
incurred. No attempt seems ever to have been made t
economise by altering the *principle* of its application, in fac
no mechanical appliance has hitherto been at our disposa
wherewith to use this medium to the best advantage. It
now proposed to shew how this difficulty has been at las
overcome.

Having shewn the superiority possessed by felt an
charcoal, it only remains to shew the advantages possessed b
a combination of these two excellent media as now introduce
in the principle of the " FILTRE RAPIDE."

This filter consists in the construction of a rigid an
hollow frame, Fig. 1, on which is stretched a felt strainer o
bag, laced at the top, Fig. 2. In the larger filters a serie
of these frames are placed parallel to, and within a shor
distance from one another, Fig. 3.

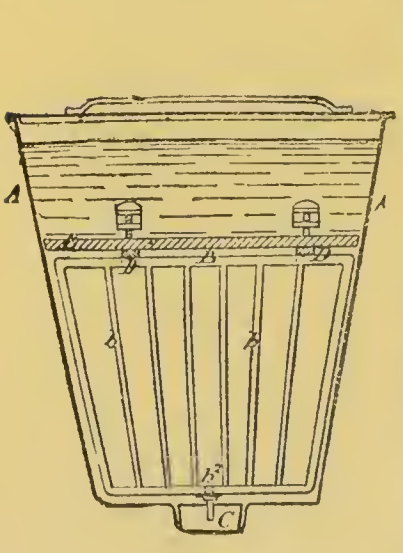


Fig. 1.

Fig. 2.

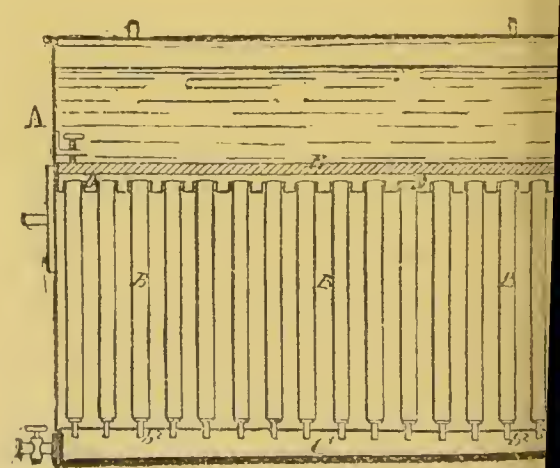


Fig. 3.

It will easily be seen that by this arrangement the surfa
presented to the liquid to be filtered is considerable. T
filtering principle of " Hippocrates's sleeve " is here reverse
the current of water passing from the outside to the inside

the bag, causing a very much more effective action, economising space and rendering the process of cleansing much more easy.

The felt alone would prove a strainer of fine density, but a far greater degree of efficiency is obtained by the addition of charcoal in the following way :

The filter is filled up with water, the outlet tap is opened, and the water quickly percolates through the felt on its way to the exit tubes, thus establishing a current through the pores of the bag. At this stage a given quantity of finely powdered charcoal, varying from one pound to three pounds, according to the quality of the water and the rapidity of flow required, per 1,000 square inches of filtering surface, is mixed with the unfiltered water, the particles of charcoal following the current adhere to the surface of the bag, and quickly close up every cranny, and in a few moments the whole bag is found coated over by a beautiful thin even layer of charcoal, from which the water issues of surprising brilliancy.

If the interior of the bag could be seen now, it would present a curious spectacle; all the fine spray formed by the issue of the minute fluid threads from the felt and charcoal playing across one another as they fall to the bottom of the frame. But this very action in the interior of the frame is one of the great advantages of this novel principle of filtration.

One or more air pipes (which are not shown in the above drawings), provided at the top with a ball of cotton wool for purifying the incoming air, serve as it were as breathing holes for the filtered water, and the water spray issuing free into the pure air absorbs oxygen (just as blood absorbs the same element in passing through the minute capillaries in the lungs) and so issues out full of the flavor of perfect aëration.

What a contrast is this to the gravel matrix of the ordinary filter fed! Both the gravel and the arterial drains

being always kept charged with water (even when the filt is being cleansed), can serve only as conduits without addi anything to the vitality of the water passed through them !

It may be urged that this complete action is only of sho duration. True, the charcoal continues rapidly to arrest th impurities in suspension until the outer skin of charco becomes clogged and the rate of filtering declines. But the the filter has given notice that it requires cleansing, an although the head on the filter may now be increased, n dangerous streamlets will appear in weak places as with sand for the filtration will continue perfect till, owing to the slo rate of filtration, it becomes compulsory to cleanse the filte This is simply done by removing the frames and smartl brushing off the charcoal in which the impurities have lodge and from which they can afterwards be in part separated b washing and exposure to the sun. But the quantity c charcoal dust used in this way is so small, and the cost s little, that it would be as well to sell it for manure after first use, and charge the filter afresh with new charcoal.

Of course the number of days that this charcoal wi exert a chemical action will depend on the greater or lesse quantity of impurities in the water.

Saussure has found that charcoal prepared from box woo absorbs during the space of twenty-four or thirty-six hours—

90	times	its volume of	ammoniacal gas,
85	„	„	hydrocloric acid,
35	„	„	carbonic acid,
9.35	„	„	oxygen,
1.75	„	„	hydrogen.

If the water were very impure the space between ea and above the frames of the "FILTRE RAPIDE" could be fill with broken lumps of wood charcoal or with granular anim charcoal, which has a more powerful action on organic matt

The fine sand used in ordinary beds appears to have two-fold action, that of straining and that of attracting partic

on its surface; but the finely ground vegetable charcoal, in addition to its chemical effect, has the straining and adhesive properties in a much more efficient degree. With a charcoal coating of only $\frac{1}{8}$-inch, a nett "adhesive surface" of 20 square inches is offered to the water over every square inch of the filtering-frame; and the "adhesive surface" of one single filter, No. 16, with 50 frames, will amount to 4,500,000 square inches.

Sixteen of these filters will go in two rooms 30 ft. by 30 ft., and give 120,000,000 gallons of water per week.

One of the great advantages of the division of the filtering surface in a number of filters is that they can be cleansed one after the other without interfering with the general rate of filtration. For instance, one or two might be cleansed every day, so that there would always be 14 or 15 at work, or any smaller number so as to suit the exact requirements of the hour, thus avoiding the bad principle of storing filtered water.

By the process advocated here it will be seen that there would be no necessity for "subsiding reservoirs." In times of flood the coarser impurities could be removed by a preliminary filtration through felt alone; at the same time the organic matter would be oxidised by the action of the air in the frames.

There would be none of the great inconveniences that now accrue from the extremes of weather in summer and winter, no evaporation and no frozen reservoirs.

If the water supply of cities, towns, and villages were all filtered on this principle there would be little need for household filters. But, as isolated places, at home and abroad, depend on an independent supply derived from wells or from the Rain-water collected from the roofs, a few words on household filters may not be out of place. Mr. W. Ripley Nichols, who wrote on the question only last year, lays down the following principles to guide intending purchasers :—

Household filters, he says—1st, must be made of a material

which cannot communicate any injurious or offensive qualit to the water which passes through it. 2nd, the filter mu remove from the water all suspended particles, so as to rend it bright and clear. 3rd, the filter must either be readil cleansed, or the filtering material must be such as to be readil renewed.

In addition to these *requirements* it is a great advantag if the filter is able to remove a noticeable amount of dissolve organic matter which most waters contain.

The same author condemns all faucet filters capable o being screwed on to an ordinary water-tap, as the volume c water, which must flow through an extremely limited amoun of material, prevents such filter acting in any other way tha as a strainer.

And he protests against the idea that any filter can b "self-cleansing."

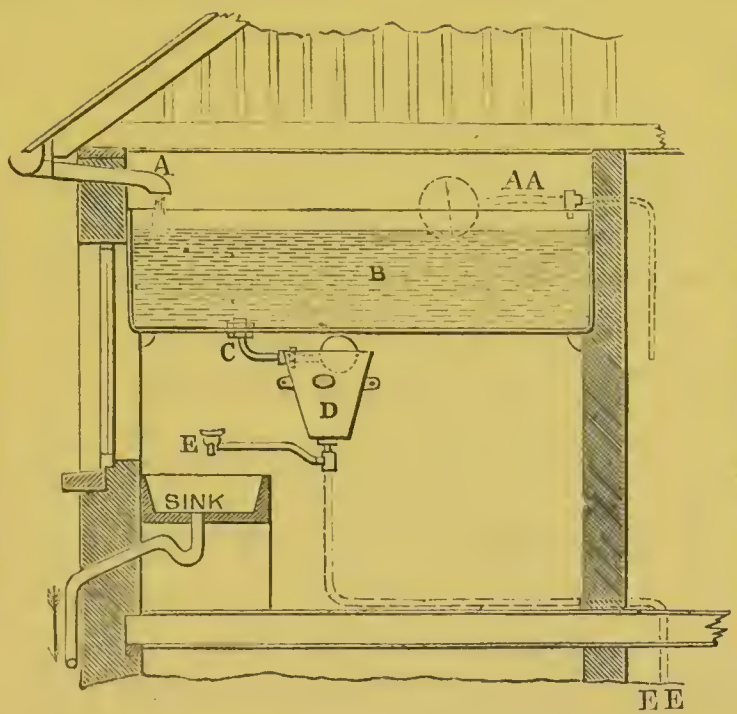
Trusting in that illusion, householders are apt to leav their filters for many months, and perhaps even years, withou cleansing them. In the meantime, the accumulated organi matter, vegetable and animal, has begun to decay, and mos likely causes the water passing through to become of poore quality than it would be if left without filtration.

Sponge filters, says the same author, left to themselve do more harm than good.

Considering that most of the filters now in use belong t one or the other of these three classes, need we wond that thoughtful men like Dr. MacAdam condemn filte altogether ?

The Service "FILTRE RAPIDE," (Class C), possesses the thr requirements mentioned by M. Ripley Nichols, together wit the chemical action on the dissolved organic matter whic is so desirable. It has one other advantage which has be little thought of, that of aërating the filtered water so as give it the sharp and brisk taste nowhere found in ordina filtered water, and a further most important perfection, th of purifying the air which enters the filter.

Fig. 4 shows the application of our system to household purposes.



A Rain-water pipe from the roof.
AA Supply from the main.
B Water tank.
C Outlet of water tank leading into filter.
D "Filtre Rapide."
E Draw-off tap for filtered water.
EE Pipe conveying filtered water to lower floor.

A "FILTRE RAPIDE," No. 3C, containing about 11 gallons, and capable of filtering from twenty to forty gallons of bright and pure water per hour, is placed against the wall underneath the cistern, and is connected therewith by means of a union and a ball-cock in the filter. The pure water may either be drawn straight from the filter or carried down to the lower floors by the ordinary service-pipes.

To cleanse it both unions are undone, the filter tilted over, the frame taken out, brushed and washed like any ordinary household utensil.

Duplicate frames may be kept in the house, so that the filter may be re-set at once, without leaving the house for more than a few minutes without *fresh* filtered water.

In these household filters it is always safer, and they will not require cleansing so often, if the space each side and above the frames is filled with granular animal charcoal, with this arrangement we guarantee to make the London rain water, gathered from the roofs of houses, "fit to drink,"

Where animal charcoal is not easily procurable, every

householder can manufacture his own wood charcoal with little trouble. The formula given by the *Popular Encyclopædia* is as follows: "Billets of wood are piled together in a pyramidal form, with vacuities between them for the admission of air, covering them with earth and setting fire to them."

A great deal more could be said on this vast subject—which is now exciting public interest, and occupying the attention of the Legislature—but to adhere to our title we shall conclude by asking the serious consideration of the reader for these few words on the Art of Filtration.

OPINIONS OF THE PRESS.

Daily Chronicle, 27th Sept., 1879.

"Maignen's Patent 'Filtre Rapide' is unique; it is based on a principle peculiarly its own."

Weekly Times, 26th Oct., 1879.

"Maignen's Patent 'Filtre Rapide' establishes the truth of two principles which appear to have remained until now practically undiscovered. The first is that the speed of effective filtration is in direct proportion to the filtering surface to which a liquid is exposed; the second is that a thin filtering bed (of fine material) is more efficacious than a thick one (of coarse material)."

Sanitary Record, 6th June, 1879.

"Maignen's Patent 'Filtre Rapide' is certainly novel in appearance and differs from all filters now before the English public."

The Times, 19th June, 1879.

"In Section VII. (of the National Water Supply Exhibition) several filters have been added, the most important being a large 'Filtre Rapide', which is worth the attention of those who need large quantities of filtered water."

Ironmonger, 7th June, 1879.

"The invention of M. Maignen deals not only with water (which it can be made to purify on a very large scale), but will also filter any kind of liquid, and with very little trouble."

Builder's Weekly Reporter, 7th Nov., 1879.

"The action of Maigen's Patent 'Filtre Rapide' is very rapid, and the simplicity of the invention commends itself."

Iron, 26th December, 1879.

"A particular and very ingenious principle is made use of in this filter to insure a uniform and fresh layer of filtering material for each usage . . . . There is a wide field for it amongst the householders and public institutions."

Inventor's Guardian, 3rd January, 1879.

"Maignen's Patent 'Filtre Rapide' offers the best facilities we have seen for easy and frequent cleansing, and at the same time offers the most perfect filtration over an extremely large surface, fully justifying its title of 'Filtre Rapide.' The system seems applicable to even the extended wants of water companies as well as to household purposes."

The Architect, 22nd Nov., 1879.

"With Maignen's Patent 'Filtre Rapide' any filtering medium may be used—animal charcoal, carbonate of lime (Clark's process), carbonate of magnesia, filtering paper; but for choice, naturally, vegetable charcoal is preferred for its superior purity."

Morning Advertiser, 22nd Oct., 1879.

"Maignen's Patent 'Filtre Rapide' is adapted for domestic use on a small scale, or it may be extended to the great scale of practice necessary for the London Water Companies."

Mineral Water Trade Review and Guardian,
October 18th, 1879.

"We believe Mr. P. A. Maignen's 'Filtre Rapide' must come largely into use among mineral water makers in the United Kingdom, as it appears to combine the three requisites—simplicity, economy, and efficacy."

The Licensed Victualler's Guardian, 4th Oct., 1879.

"Maignen's Patent 'Filtre Rapide, will be found especially useful when large quantities of water have to be filtered quickly. It is an invention based on strictly scientific principles, but yet very simple in action."

City Press, 14th April, 1880.

"The water filters of Mr. P. A. Maignen will no doubt suggest the most frequent use of purified water."

British Mercantile Gazette, 28th April, 1880.

"Its application to the clarifying and purifying of rain-wate alone promises a large field for Mr. Maignen, as besides helping t solve the water question, it will introduce quite a luxury into house in providing soft water for washing and cooking purpose We have seen Whitechapel rain-water and Thames water, take near Tower Hill, issue from the 'Filtre Rapide' fit to drink."

Naval and Military Gazette, 28th April, 1880.

"Mr. Maignen's 'Filtre Rapide' appears to combine simplicit with economy and efficiency. It differs from all filters hithert introduced."

The Architect, 1st May, 1880.

"The 'Filtre Rapide' of Mr. Maignen's has developed a ne sphere of usefulness. By attaching the filtre to a cistern o reservior the rainfall can be utilised, and a supply of soft water, boon for baths and washing purposes, secured. By the addition o an air-pipe attached to the top of the filter frames, oxygen is give to the water as it percolats, and thus the water is aërated on it passage, making it palatable, as well for drinking purposes."

Ironmonger, 15th May, 1880.

"The principle of the 'Filtre Rapide' is decidedly original, th filtering being conducted by lateral pressure against perpendicula media, as distinguished from the downward pressure in all othe filters, as the pressure of water is according to its height and are at the base; it is clear that a much greater weight is present o the filtering medium by the usual process than by Mr. Maignen system, and this, he contends, is more calculated to force minut particles through some of the media employed than is possible i his, where the water percolates rather than filters."

Sanitary Record, 15th May, 1880.

"In respect of filters, we may mention with approval th 'Filtre Rapide' of Mr. Maignen, of London, so easy to cleanse."

British Trade Journal, 1st June, 1880.

"The 'Filtre Rapide' is a simple contrivance, which mu come to the front, for it deals with the purification of water in manner that not only commends itself to the notice of 'the powe that be,' but to every individual householder."

Daily News, 7th June, 1880.

"Of the average London water, it may be said that it is n good, but that with a great apparatus of filters it may possibly drunk."

A. Southey, Printer, 14, Cullum Street, London, E.C.